INDUSTRIAL EDUCATION

10-20-30 POWER TECHNOLOGY

CURRICULUM GUIDE

Alberta
EDUCATION
1976

I N D U S T R I A L E D U C A T I O N

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ALBERTA EDUCATION

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A C K N O W L E D G E M E N T S

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NOTE: This Curriculum Guide is a service publication only. The Senior High School Program of Studies contains the official statement concerning Senior High School Industrial Education. The information contained in the Guide is prescriptive insofar as it duplicates that contained in the Program of Studies. There are in the Guide, however, as well as content, methods of developing the concepts, suggestions for the use of teaching aids and lists of additional reference books.

NOTE:

Industrial Education 10, 20 and 30 is made up in four (4) packages according to career fields.

Teachers may select modules from a number of fields and consequently will need those packages that contain the content for the modules they plan to teach.

The packages are color-coded and contain the following career fields:

A. Electricity-Electronics - yellow
B. Materials - green
C. Power Technology - blue
D. Visual Communications - orange
E. The general modules of Research, Development and Production Science will be found in each package.

Study the content of the modules carefully and select those that best meet the needs of the students in the school, your own competencies and the availability of tools and equipment.

TABLE OF CONTENTS

I. INTRODUCTION

The Industrial Education 10, 20, 30 series of courses is designed to provide exploration of, and orientation to, a wide variety of career options. These courses provide guidance to students to help them select more in-depth courses for occupational preparation or simply add to their technological "know-how".

Through the program, students are able to work in an environment which is conducive to challenging their intellect and developing their talents in a number of technical and craft areas. Students become aware of the interrelationship and the dependency of one technology upon the others. They have the opportunity to develop an understanding of the principles and skills required in the various occupations. Students will have many opportunities to apply academic skills learned in other subjects to their lab work.

II. PHILOSOPHY

Industrial Education adds a new dimension to the program for educating young people at the secondary school level. For many students it will open new options to help prepare them for the life ahead while enjoying their studies now. The authors of the Industrial Education curriculum recognize that the needs of society have changed, and with them the approach to knowledge acquirement. Students today must be helped to learn how to learn, to conduct inquiry, to study independently, to make choices and decisions, to use technology, and to live with change.

The Industrial Education program is concerned with career development. Because careers today do not develop along predictable lines, our education program must provide considerable flexibility so that students have an option of several career choices. This is possible for several reasons. A person who has been broadly educated is able to learn what he needs to know, within limitations, about a new job. With the general education level of the society rising, the future worker needs broad as well as experience-based education. Such an education offers him subsequent chances for rapid and successful specialization. With this in mind the learning experiences should be such that they become the basis upon which specialization can be built.

Our task in the secondary school then, is to provide students not only with entry skills for several careers but to orient the program to meet social and cultural goals. This means that the various courses or disciplines must be interrelated. Industrial Education provides a unique opportunity for the teacher to demonstrate these relationships and further, to capitalize on them by means of the motivation created through practical applications.

Thus the experiences to which students are exposed should provide them with realistic criteria for career guidance.

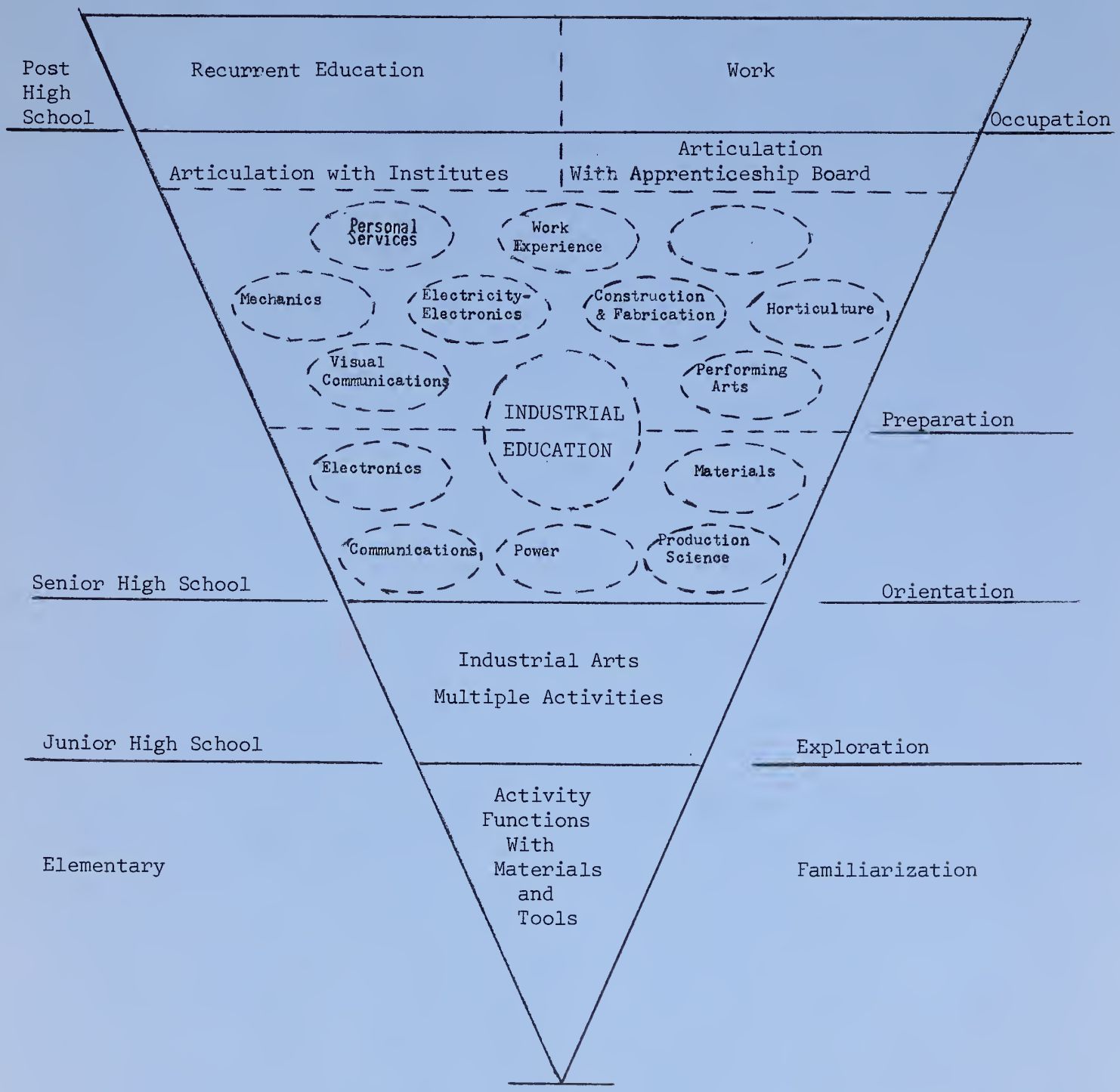
Industrial Education is a program consisting of courses that provide a continuum of experiences, starting with exploratory experiences and activities in the elementary and junior high school, expanding in the high school to the development of skills in career fields and culminating in on-the-job experience.

Industrial Arts, the exploratory phase of the continuum, provides the opportunity for the students to explore, reason, experiment and discover the reality of the technological society in which they live. The content of the program deals with industry, its organization, materials, processes, products, occupations, and the problems resulting from the impact of technology on society.

Following the exploratory phase, students may begin orientation studies in a career field. They may select modules of a more general nature in the Industrial Education 10, 20, 30 series or alternately take an introductory 12 course related directly to a career field. From here they advance to the more specific courses in the Industrial Education 22-32 program which prepare them for a career.The chart on page 3 illustrates the Industrial Education Program in conceptual form, showing the advancement of a student from the awareness or familiarization stage to exploration, orientation, preparation and finally,an occupation. These courses provide in-depth experiences in the development of skills in tool and machine operation, material processes, drawing and interpretation and a knowledge of the basic concepts related to the technologies. All the courses place emphasis on practical work and applied theory.

FOR

CAREER CHOICE AND DEVELOPMENT



Legend: ———— Solid line indicates levels.

------- Broken lines and open spaces indicate opportunity to transfer to other options.

III. OBJECTIVES

The objectives of Industrial Education 10, 20, 30 are as follows:

A. Personal Growth

To provide opportunities for the individual growth of the student through the development of acceptable personal and social values necessary in a productive society.

1. To provide a technical environment which motivates and stimulates individuals to discover their interests and develop personal and social responsibilities.
2. To assist in the development of positive attitudes toward safety.
3. To assist in the development of positive attitudes towards conservation and ecology.
4. To assist in the development of consumer values.

B. Career Exploration

To provide the student with experiences which will assist in making realistic career choices.

1. To provide students within a technical environment an opportunity to become acquainted with the skills, technical requirements, working conditions, responsibilities, opportunities and rewards in a variety of career fields.
2. To relate their own interests, abilities, likes, dislikes and values to several career fields.

C. Occupational Skills

To develop basic competencies, integrating cognitive and psychomotor skills to enter a family of occupations or post-secondary institutions for further education.

1. To provide exploratory experiences in the use of tools, equipment, and materials appropriate to various technologies prevalent in a productive society.
2. To develop an understanding of the interrelationships of various technologies.
3. To provide a technical environment for students to synthesize their accumulated knowledge in the solution of practical problems.
4. To assist the student to develop habits that will be conducive to the establishment of a safe environment.

I V . O R G A N I Z A T I O N

A. Program Organization

The Industrial Education 10, 20, 30 courses consist of 55 one-credit modules of content. The modules are categorized into career fields. Four career fields, i.e. Graphic Communications, Electricity-Electronics, Materials and Power Technology have the content of the modules outlined in this guide.

1. Regular Program

Courses may be made up by arranging combinations of modules drawn from the fifty-five available modules. These should be selected carefully to meet the needs of the students while at the same time providing appropriate consideration to factors such as suitability of facilities, equipment availability, supply costs and teacher experience or training. Each course may be taught for 4 or 5 credits (100 - 125 hours). The content for each module may range from 25 - 33 hours. Four modules of 33 hours each would provide the necessary time for a five-credit course. Four 25-hour modules would meet the time requirements for a four-credit course. The selection and sequence of modules is left to the teacher's discretion.

Procedurally, students will register in a course made up of four modules. The first four modules taken by a student would normally be registered as Industrial Education 10A. The next four modules would become 20A and the third set of four modules would be 30A. If some students wished to enrol in further Industrial Education courses, the next course would become 10B, with 20B and 30B following. It would be possible for students to arrange different sequences of courses if it is thought advisable. For example, one sequence might be 10A, 10B, 20A, 20B, 30A, 30B; another might be 10A, 20A, 30A, 10B, etc. Sequencing of courses will be left to local authorities. Examples of courses are as follows:

IE 10A (4-5 credits)	IE 20A (4-5 credits)	IE 30A (5 credits)
IE 10B (4-5 credits)	IE 30A (4-5 credits)	IE 30B (5 credits)

2. Special Consideration

In schools where vocational courses are taught, teachers have the option of using content from the "12" courses to make up the 65 hours required as prerequisite to the "22" courses. That is, in a composite high school where unit shops are available, students could be scheduled into two shops for a total of 125 hours, e.g. Auto and Welding. They could then advance to a "22" course in either or both of the two.

Students in the Industrial Education 10 program would be required to take two modules for 33 hours each, directly related to the "22" course for which they are earning the prerequisite. For example, a student would have entry to a "22" program by taking two closely related units, plus two others:

e.g. Basic Woods (33 hrs.)
Building Construction (33 hrs.)
Architectural Drawing (33 hrs.)
Basic Wiring (33 hrs.)
66 hrs. permit entry to Building Construction 22

Approximate Total 132 hrs. = 1 Industrial Education course (5 credits)

B. Guide Organization

The course guide is organized on the following pattern:

1. Career Field

All the modules are classified in four career fields.

Graphic Arts
Electricity-Electronics
Materials
Power.

2. Module Topic

Each module will be identified by a topic title.

3. Generalization

The first column describes the generalization or "big idea" that students should learn. A generalization expresses a relationship between two or more concepts. It is a statement of fact which is true in more than one situation.

4. Technical and Common Concepts divide the topic into categories of information that are reduced to single ideas. The technical concepts are specifically related to the topic. The common concepts used in the context of this guide are concepts that have relevance for all the topics.

5. Learning Tasks

The learning tasks column describes what activities students are expected to engage in.

6. Behavioural Objectives

These describe specific changes in student behaviour which result from the learning tasks performed.

An objective is a statement describing the intended outcome for the learner. Three kinds of instructional objectives are used:

- The cognitive objectives are those concerned with knowledge. They are characterized by such terms as "identify, differentiate, analyze".

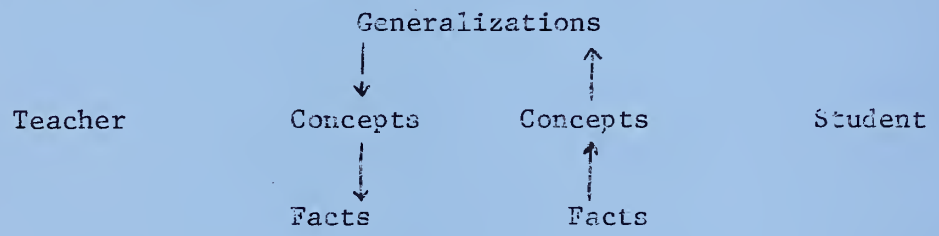
- The affective objectives are those concerned with feeling. Such terms as "awareness" and "value" illustrate the affective objective.

- The psychomotor objectives are those concerned with skills and applied knowledge. They are expressed by the terms "develop skills in", and "extend skills".

The guide gives only a few sample behavioural objectives. It is the responsibility of the teacher to develop as many behavioural objectives as he/she can teach in the time available.

Facts are taken to be items of specific information, concepts are categories of information and generalizations express the relationship between concepts.

In planning a lesson, the teacher moves down this hierarchy, whereas in learning, the student begins with the facts and moves upward.



C. Facility Organization

The organization of the phsyical facilities is in part determined by the original plan. There are, however, adjustments that can be made in the layout by the teacher to accommodate his/her style of teaching. The number of students in a class affects the way the lab or shop is organized. While most of the shops in Alberta are designed for 16 to 20 students,a number of factors must be considered in the final assignment of class load. These factors include:

1. physical size of the shop or laboratory
2. type of student
3. amount of equipment
4. type of programming
5. type of course
6. training and experience of the teacher.

Safety of the students and their opportunity to obtain teacher contact are important considerations when class loads are determined.

V. E V A L U A T I O N

Evaluation of student growth should be based on stated behavioural changes and specific criteria understood by the students. Allowance should be made for both self and teacher evaluation and, in some cases, peer evaluation. Evaluation should be based on the three domains of learning as defined by an Alberta committee of Industrial Education teachers. These categories are as follows:

1. Verbal and Written Communication

2. Personal Growth

3. Manipulative Skills.

The weighting given each of the three measures will depend on the nature of the behaviour being evaluated. For a more detailed treatment of evaluation see the Industrial Education Handbook (Alberta Education, 1976).

V I. C O N T E N T

The following are the titles of modules in the Industrial Education 10, 20, 30 course.

A. Electricity-Electronics (yellow package)

1. Electricity
2. Electronics
3. Power Supplies
4. Amplifiers
5. Audio
6. Servicing
7. Radio
8. Television
9. Logic Circuits
10. Computer
11. Electric Wiring
12. Design and Construction

B. Materials (green package)

1. General Woods
2. Building Construction (two units)
3. Cabinet (two units)
4. General Metals
5. Sheet Metal
6. Hot Metals (three units)
7. Plastics (two units)
8. Earths (two units)
9. Textiles
10. Foods

C. Power Technology (blue package)

1. Conventional Heat Engines
2. Small Engine Tune-Up and Trouble Shooting
3. Small Engine Overhaul
4. Automobile Care
5. Automobile Tune-Up
6. Mechanical Systems
7. Electro Mechanical Controls and Circuit Trouble Shooting
8. Electrical Systems
9. Non-Conventional Power Sources
10. Appliance Repairs and Trouble Shooting
11. Hydraulics and Fluidics
12. Pneumatics and Fluidics

D. Visual Communications (orange package)

1. Principles of Offset Lithography
2. Line Photography
3. Black and White Photography
4. Color Photography
5. Screened Photography
6. Layout and Design
7. Offset and Printing Production
8. Mechanical Drafting

9. Topographical Drafting
10. Architectual Drafting
11. Relief Printing
12. Print-Making Techniques

E. General

Three modules of a general nature also are available. These are:

1. Research module
2. Developmental module
3. Production Science module.

C. POWER TECHNOLOGY

Modules

C. POWER TECHNOLOGY

INTRODUCTION

Power and energy are generally considered to be one and the same. With the concern for the efficient utilization of energy, the study of power technology takes on increased significance.

There are twelve one-credit modules of content which provide the students and teacher considerable choice in building the type of program best suited to the situation. The modules are exploratory by nature with an emphasis on the concept generalization format.

The concepts given priority in power technology are:

1. Energy conversion
2. Energy transfer
3. Energy utilization.

In addition, the eight concepts common to the total program are studied where appropriate in each module. These are:

-Consumer Education
-Environmental implications
-Graphic interpretation
-Measurement
-Career information
-Safety
-Technological implications
-Societal implications

The systems approach, beginning with the system and progressing through units, components and principles, is a useful method of developing an analytical approach to problem solving. This approach works particularly well for teaching power technology. It is hoped that every action - past, present or future - will be examined in terms of its costs, benefits, and consequences.

The modules as listed may be selected in any order or combined to make a cluster related to a career area. Two modules taught for 65 hours will serve as a prerequisite for the 22 level courses in Automotives, Related Mechanics, or Aircraft Maintenance.

I. OBJECTIVES

The objectives of the modules in Power Technology are:

1. To make the students aware of a number of ways to convert energy forms and to use various methods of transferring the converted energy to an intended use.

2. To give the students an opportunity to practice trouble shooting techniques utilizing analytical thinking.

II. CONTENT SUMMARY

Power Technology

1. Conventional Heat Engines
2. Small Engine Tune-Up and Trouble Shooting
3. Small Engine Overhaul
4. Automobile Care
5. Automobile Tune-Up
6. Mechanical Systems
7. Electro Mechanical Controls and Circuit Trouble Shooting
8. Electrical Systems
9. Non-Conventional Power Sources
10. Appliance Repairs and Trouble Shooting
11. Hydraulics and Fluidics
12. Pneumatics and Fluidics

III. REFERENCES

These are listed under each module.

IV. CONTENT

Generalizations, concepts and behavioural objectives are outlined on the following pages. Teachers are expected to develop additional behavioural objectives and activities to supplement the identified content and maintain relevancy.

MODULE ONE

CONVENTIONAL HEAT ENGINES

I. OBJECTIVES

The objective of this module on Heat Engines is to allow the student to compare several internal and external combustion engines to determine their relative efficiency with respect to energy conversion, transfer and utilization.

II. REFERENCES

Duffy, Joseph W. POWER,PRIME MOVER OF TECHNOLOGY. Van Nostrand. 1972.

TOPIC CONVENTIONAL HEAT ENGINES

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
1. The combustion of fuel converts chemical energy into mechanical energy.	1. Energy Conversion a. Energy -Potential -Kinetic b. Combustion -Internal (Chemical and Mechanical) -External (Chemical and Mechanical)	a. Learn to define terminology.	The student will: a. Given the reference material -differentiate between potential and kinetic energy -define combustion. -define chemical energy -define mechanical energy
	*Safety	b. Learn safe procedures for operating engines.	a. List the correct and safe procedures for starting an engine -identify safe acts and conditions.
		c. Use operator's manuals, observe and record data.	b. Given a four-stroke cycle engine, safely operate and control it as directed in the operator's manual.
		d. Use tools and materials correctly.	c. Given a steam engine, safely operate and control the engine as directed by the operator's manual.
	*Measurement	e. Learn units of measurement and their application.	

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
2. Conditions for combustion have significant effects on the efficiency of the energy conversion process.	2. Efficiency	a. Learn to analyze an engine.	The student will: a. Given an operating four-stroke cycle engine, record observed data resulting from -change of fuel -rich combustion -lean combustion -restricted air flow and -chart the results. b. Given an operating four-stroke cycle engine and a dynomometer: -change timing -change load -change carburation -change fuel and chart the results.
	*Environmental Implications	a. Learn about implications of engines for environment.	a. Given several operational heat engines, compare the emission levels and identify the strengths and weaknesses of each engine.
3. To be useful, converted energy must be controlled and transmitted.	3. Energy Transfer a. Control	a. Identify control factors.	a. Given an operating heat engine and a dynomometer, note the results from the following manipulations: -fuel -air fuel ratio -load -speed and chart the findings.

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
			The student will:
	b. Transmission	b. Study mechanical systems and support systems.	b. Given two internal combustion engines and two external combustion engines, trace through the mechanical system required to transfer the converted energy.
		c. Learn meaning of efficiency.	c. Given several operational heat engines and a dynomometer, calculate and chart their efficiencies.
. The utilization of converted energy and the means to control and transfer it has resulted in an industrialized society.	4. Energy Utilization a. Work-Horsepower	a. Analyze an engine for horsepower.	a. Given access to reference materials, determine the applications of heat engines and their emission performances.
	b. Force-Torque		b. Given several operational heat engines and a dynomometer, accurately graph the characteristics of each engine as to: -developed horsepower -fuel consumption -developed torque -efficiences.
	*Consumer Knowledge	a. Obtain information on products from reference materials.	
	*Sociological Implications	a. Study sociological implications in areas of: -economics -human mobility -individual needs -societal changes.	a. Drawing from his own background, discuss how heat engines affect his life, societ as a whole and especially the industrialized societies.

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
	*Occupational Information	a. Learn how to get occupational information: -salaries -education -duties -working conditions -physical requirements -service -sales -manufacturing.	The student will: a. Given the Canadian Classification and Dictionary of Occupations (C.C.D.O.), find information related to the field of mechanics.

* Common concepts in *script*. These are concepts common to most units.

MODULE TWO

SMALL ENGINE TUNE-UP AND TROUBLE SHOOTING

I. OBJECTIVES

The objectives of Module Two, Small Engine Overhaul and Trouble Shooting, are to:

1. Allow the student to repair, adjust and control various small engines to achieve more efficient conversion, transfer and utilization of energy.

2. Provide the student with the procedures and practice to develop a logical system of procedures for analyzing and tuning a small engine.

II REFERENCES

CROUSE. Small Engines: Operation and Maintenance. McGraw-Hill.

PIPE, Ted. Owner's Manuals. Small Gasoline Engine Training Manual. Sams. (Latest Edition).

ROTH. Small Gas Engines. Goodheart-Wilcox.

Small Engine Service Manual. Sams. (Latest edition).

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
1. A small engine tune-up technician requires a knowledge of work, power, torque and the principles of internal combustion in order that he may tune an engine to efficiently convert chemical energy into mechanical energy.	1. Energy Conversion: a. Energy -Potential -Kinetic -Chemical -Mechanical	a. Operate and control a small engine.	a. Given a small engine in good conditio operate and control the engine unit a be familiar with all the controls re-quired to properly operate the engine
	b. Measurement of -Work -Power -Torque	b. Define terms.	b. Given appropriate reference material fine: -potential energy -kinetic energy -chemical energy -mechanical energy -work -power -torque -combustion -efficiency -compression ratio.
	c. Combustion: -Internal	c. Identify and define energy conversion units.	c. Given a cut-away model of a small eng and suitable reference material, iden fy and define the function of the mag and the combustion chamber.
	d. Efficiency: -Volumetric -Thermal -Air Fuel		

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
	e. Conversion Units: -Magneto -Mechanical-Electrical -Combustion-chamber -Chemical-Thermal.		
2. Internal combustion which produces thermal energy is obtained by releasing electrical energy in the presence of confined potential chemical energy.			
3. Efficient combustion and transfer of energy developed due to internal combustion is dependent on properly functioning control and transmission components in the units of the system.	2. Energy Transfer: a. Energy -Electrical -Mechanical -Chemical	a. Identify control and transmission units.	a. Given appropriate reference material and paying particular attention to control and transmission, define the function of: -the carburetor -the magneto and ignition -reciprocating to rotational conversion unit.

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
	b. Energy: -Control Transmission	b. Test engine for magneto output, compression, fuel supply to carburetor and combustion chamber.	b. Given a small engine, explain to the teacher how the control and transmission units studied in a) above function.
	c. Combustion: -Internal.	c. Test spark plugs.	c. Given the correct procedure for trouble shooting, examine the engine to determine its condition based on standards of a properly functioning one.
	d. Efficiency.	d. Identify unsafe conditions and procedures.	
	e. Carburation.	e. Measure volumetric efficiency and brake horsepower.	
		f. Compare leaks, horsepower and torque curves.	
	* *Safety* * *Measurement*		

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
. Regular and proper tune-up of a small engine will increase the efficiency through more complete combustion.	3. Energy Utilization		
	a. Carburetor Airfuel Ratio	a. Identify and use tools and equipment correctly.	a. Given an inoperative engine and suitable reference material, identify the problem and use tools and instruments correctly to tune and adjust the engine.
	b. Ignition -Timing -Strength	b. Trouble shoot an engine.	b. Given an inoperative engine and by following an accepted trouble shooting procedure,check the engine, record the results, analyze the data and diagnose the cause of the malfunction. Discuss this diagnosis with the teacher.
	c. Efficiency -Volumetric -Thermal	c. Establish safe acts and conditions.	c. Given suitable information on safe acts and conditions, instructions for measuring and test equipment, adequate tools and repair instructions, tune an engine to function efficiently.
	d. Lubrication	d. Discuss engine design for easy repair.	d. Given suitable test equipment along with operating instructions, determine the thermal and volumetric efficiency of the engine, measure the torque, calculate the horsepower and analyze the data to determine the level of operating efficiency for the engine.
	e. Power -Torque -Horsepower		
	* *Safety Consideration*		
	* *Consumer Awareness*		

* Common concepts in *script*. These are concepts common to most units.

TOPIC SMALL ENGINE TUNE UP AND TROUBLE SHOOTING

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
5. The degree of combustion of fuels and proper lubrication determine the torque produced and the quality of emission.	* *Societal Implications* * *Occupational Awareness.*	Learn to: a. Determine cost-benefit factor of repairing an engine. What societal, economic and environmental implication does tune-up and repair have in the long run?	The student will: e. List possible career areas in small-engine repair.

* Common concepts in *script*. These are concepts common to most units.

MODULE THREE

SMALL ENGINE OVERHAUL

I. OBJECTIVES

1. To make the student aware of the physical requirements necessary for efficient energy conversion, energy transfer and energy utilization in a small engine.

2. To use tools correctly and follow standard procedures for overhauling a small engine.

II. REFERENCES

PIPE, Ted. Small Gasoline Engines; Training Manual. Sams. (Latest Edition).

ROTH. Small Gas Engines. Goodheart-Wilcox. 1975.

Small Engines; Service Manual. Sams. (Latest Edition).

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn about:	The student will:
1. Energy is converted from one form to another throughout the engine system.	Energy Conversion		
	a. Energy -Potential -Kinetic -Thermal -Mechanical -Electrical -Chemical	a. changes in energy forms.	a. Demonstrate an understanding of energy conversion throughout an engine system.
	b. Motion -Reciprocating -Rotational		b. Identify the various mechanical parts and the engines that change energy forms.
	* *Graphic Interpretation*	a. interpretation of operator's manual.	a. Read an operator's manual to identify parts and learn the vocabulary.
	* *Safety*	a. safe acts and safe conditions.	a. Discuss safety as it relates to small engines and their maintenance.
		b. safe use of tools and equipment.	
		c. safe use of test instruments -dynamometer.	

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
. Complete combustion and efficient energy transfer is dependent on proper lubrication and adjustment and components' tolerance.	Energy Transfer a. Energy -Central -System -Transmission -Systems	a. Use trouble shooting procedure.	a. Given a small engine which in some way does not meet the manufacturer's performance specification, observe safe acts and conditions, follow acceptable trouble shooting procedures and analyze the system to determine the units contributing to inefficient performance of the system.
	b. Efficiency -Lubrication -Tolerance and Specification -Combustion -Component -Wear -Replacement	b. Inspect, check and test condition of system. c. Calculate and record data.	
. After extended use of a small engine system, overhaul of the system is necessary to determine that all energy transfer control and transmission components meet tolerance specifications and where tolerances are exceeded, replacement and/or adjustment is necessary to regain new engine efficiency.	* *Consumer Awareness*	a. Replace and/or adjust components which do not meet specifications.	a. Given appropriate tools and test instruments, procedures of safe acts and conditions, manufacturer's repair instructions and necessary replacement components, follow proper procedures and tool use for disassembly, overhaul and assembly of the engine.

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
4. Knowledge of work, energy, power and friction in conjunction with the proper use of appropriate test instruments is necessary to determine the degree of efficient energy utilization of a small engine system.	Energy Utilization Efficiency: a. Volumetric b. Friction -Dry -Greasy -Viscous c. Engine Power -Brake -Indicated -Fractional d. Engine Efficiency -Mechanical -Thermal	Learn to: a. Test and record data, calculate and analyze. b. Use dynamometer and other appropriate test instruments.	The student will: a. Given a reconditioned engine, perform the necessary adjustments and tests to make it operate at peak efficiency.
		Learn about:	
	* *Environmental Implications*	a. Cost, benefits and consequence of efficient energy utilization.	a. From his own knowledge and from given sources of information retrieval, considering cost, benefits and consequenc determine environmental, societal and technological implications of the smal internal combustion gasoline engines.
	* *Occupational Information*	a. Occupation information	
	* *Societal Implications*	a. Importance of small engines.	
	* *Technological Implications*	a. Significance to industry of overhauling and maintaining engines.	

* Common concepts in *script*. These are concepts common to most units.

MODULE FOUR

AUTOMOBILE CARE

I. OBJECTIVES

Through the module on Automobile Care a student will be given the opportunity to:

1. Study the various systems and sub-systems that make up an automobile.
2. Learn how to take preventive care of a car.
3. Learn the legal and social responsibilities associated with car ownership.

II. REFERENCES

Time-Life Book of the Family Car, The. Time-Life Books. 1974.

Owner's Manuals.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
1. The automobile consists of a number of systems made up of mechanical components which are designed to function as an effect whole.	Systems -Engine -Chassis -Power train -Body	a. Identify the various systems in an auto and be able to differentiate between types of systems that perform the same function	a. Given suitable reference material, identify the engine, chassis, power train and body of an automobile.
	Sub-Systems -Fuel system -Ignition system -Lubricating system -Cooling system	b. Analyze various systems and explain how they work. Define the functioning of the major components and the units in the system.	b. Given references and an engine, explai the function of each system: -fuel -ignition -lubricating -cooling.
	* *Graphic Interpretation*		
2. Automobile maintenance helps ensure that the vehicle will be safe and efficient to operate.	Maintenance	a. Perform maintenance tasks of: -inspecting -cleaning -checking -measuring -testing -analyzing -replacing.	a. Given cleaning materials and instructions, clean the interior and exterior of a car. b. Clean the exterior of the carburetor, distributor, battery, etc.
	* *Safety*	a. List unsafe acts and conditions with respect to maintenance tasks.	

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
3. Complete analysis of the car will help determine the amount of maintenance required and help in making the decision of whether to repair or scrap.		a. Use manuals to set information on data.	a. Given a check sheet, appropriate reference material and procedures for safe action, inspect and/or test the following components and record their condition: -battery electrolyte and terminals -radiator coolant level -engine oil level -transmission oil level -rear-end oil level -tire wear -ball joints and tie rod ends -brake lining and cylinders -steering gear box oil level -brake cylinder oil level -windshield washer water level -carburetor linkage -electrical system -exhaust system -clutch free pedal.
		b. Use proper procedures.	b. Given suitable instruments, analyze the condition of the carburetor and motor, recording the results on the check sheet.
	* *Measurement*	c. Use measuring instruments for checking.	c. Given the check sheet, advise the owner of the car's condition.
		d. Analyze data compiled.	d. Given the owner's consent, repair the automobile by using acceptable repair procedures.
		e. Repair unsafe or non-working components.	

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
4. The owner of an automobile has a legal responsibility to secure insurance.	* *Consumer Awareness* 4. Insurance	a. Make a record of auto costs.	a. Determine the costs, benefits and consequences to one's self and society of various amounts of auto insurance coverage.
			b. Go through the procedure of buying insurance.
		b. Compare auto owner costs with costs of public transportation	c. Study the cost of owning an automobile for -pleasure -work.
	* *Environmental Implications*		
	* *Social Implications*		a. Study the effects of automobile pollution on the environment: -locate relevant information -compile date -analyze data -determine costs, benefits and consequences to oneself and society of using the automobile for work and pleasure.
	* *Safety*	a. Learn about unsafe practices and conditions in the auto service area.	

* Common concepts in *script*. These are concepts common to most units.

MODULE FIVE

AUTO TUNE - UP

I. OBJECTIVES

This module on Auto Tune-Up will make the student aware of the various functions of the different sub-systems of an engine and how they can be adjusted to produce more efficient conversion, transfer and utilization of energy.

II. REFERENCES

Atteberry, Pat, H. POWER MECHANICS. Goodheart, 1968.

Bricker, Frederick E. AUTOMOBILE GUIDE (#23015). Audel.

Duffy, Joseph W. POWER; PRIME MOVER OF TECHNOLOGY. Van Nostrand Reinhold Ltd., 1972.

Roeing, Richard S. AUTO ENGINE TUNE-UP (23181). Audel, 1970.

"SERVICE TIPS FOR THE AUTOMOTIVE MECHANIC" Hastins Manufacturing Co.

TIME-LIFE BOOK OF THE FAMILY CAR, THE Time-Life Books, 1974.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
1. A conventional heat engine converts the chemical potential energy in the air/fuel mix into mechanical-kinetic energy through efficient combustion.	1. Energy conversion a. Energy -Potential -Kinetic -Chemical -Mechanical b. Combustion -Internal c. Efficiency -Volumetric -Thermal -Air/fuel mix * *Measurement* * *Safety*	a. Define terminology. b. Identify conditions of combustion. c. Learn units of measurement used. a. Learn to use tools and instruments safely.	a. Given appropriate references define the following: -lead-acid battery -generator -alternator -carburetor -fuel pump -distributor -ignition triangle air, fuel, spark -dwell angle -points and plugs gap -primary and secondary circuit -choke -air/fuel mixture -volumetric efficiency -thermal efficiency. b. Given the manuals and tools identify and use correctly: -combination wrenches -socket sets -feeler gauges -various meters -punches.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
			c. Given a cut away model of an internal combustion engine, trace the circuits of the following sub-systems: -air/fuel system -combustion chamber variables -ignition system -cooling system -exhaust system.
	* *Graphic Interpretation*	Locate relevant specifications.	d. Given the manual, find appropriate specifications for a given engine.
	2. Energy Transfer		
	a. Energy -Control -Transmission -Electrical -Mechanical -Chemical	a. Practice tool use and analysis of problems.	a. Given suitable references and an operating engine, analyze the systems that provide control functions.
	b. Combustion -Internal -Efficiency	b. Do trouble shooting of common problems.	b. Given test equipment, test, observe, record and calculate various efficiencies and characteristics such as: -thermal efficiency -volumetric efficiency -air/fuel ratio -torque developed -fuel consumption -dwell angle -manifold pressure -fuel pump pressure -cooling system -emission levels -compression ratio.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
			The student will: c. Given appropriate equipment and specifications, repair and adjust the following: -fuel pump and filter, etc. -carburetor -starter system -ignition system -exhaust system -cooling system -emission control system.
	* *Technical Implications*		d. Discuss common engine problems such as: -engine ping -engine will not turn over properly -engine will not start -engine misses at high speed -engine idles roughly -engine has a flat spot upon acceleration.
3. Regular and proper tune-up of an engine will increase the efficiency through more complete combustion.	3. Energy Utilization -Ignition -Air/fuel ratio -Emissions -Efficiency -Torque		a. Discuss costs, benefits and consequences of tuning an automobile engine.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
	* *Safety*	Identify unsafe acts and conditions.	a. Discuss and list typical unsafe acts or conditions and detrimental attitudes with respect to: -hoist -jacks -hand tools -use of face masks -use of power tools -exhaust fumes -cleaning solvents. b. Given an engine in need of tuning, proceed to adjust the components using logical troubleshooting and systems analysis techniques, safe practices and correct use of test equipment to observe, record and compare results.
	* *Societal Implications*	Discuss societal implications of polluting engines.	a. Using available resources, determine the implications for the individual and society of the level of performance of an engine in terms of costs, benefits and consequences.
	* *Occupational*	Find occupational information about: -services -sales -educational requirements -duties	a. Find and discuss occupational information related to mechanics.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		-working conditions -physical requirements -safety -manufacturing.	

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MODULE SIX

MECHANICAL SYSTEMS

I. OBJECTIVES

The objective of this module on Mechanical Systems is to provide the student with the opportunity to dismantle and re-assemble various mechanical systems to determine operating principles and their use in achieving an efficient conversion transfer of energy.

II. REFERENCES

Walton, Harry. THE HOW AND WHY OF MECHANICAL MOVEMENTS. Popular Science Books.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
1. It is estimated that over 95% of all productive energy is in the form of mechanical power.		a. Define the terminology.	a. Given the appropriate references, -differentiate between mechanical advantage and velocity -define: amplification torque power friction efficiency.
		b. Observe and record data.	b. Given a standard three-speed auto transmission and manual, dismantle and assemble the transmission so that the gears can be properly operated upon completion of the task.
		c. Use tools and materials.	c. Given a transmission and manual, identify each of the gear types, spline shafts, seals, bearings, supports and levers and describe the function of each.
		d. Follow instructions in the operator's manual.	
2. The efficiency of an energy conversion system is usually dependent on how well the system can overcome friction.	Energy Conversion a. Power -Torque -Force b. Efficiency -Friction c. Motion -Linear -Rotary * *Graphic Interpretation*		

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
	* *Safety*	a. Practice safe procedures.	
. The total efficiency of power transfer depends on the efficiency of each component within the transfer system.	Energy Transfer a. Transmission Devices: -Housing -Bearings -Shafts -Couplings -Belts -Gears -Chains -Levers b. Lubricants	a. Identify the principles of design involved.	
. The utilization of mechanical energy conversion and transfer has been instrumental in developing our industrial society.	Energy Utilization: a. Work -force -distance b. Power -force -distance -time c. Ratio -increase -reduce * *Social Implications* * *Environmental Implications*	a. Analyze societal implications of energy utilization as it affects: -economics -ecology -human mobility.	a. Given various mechanical devices, calculate the efficiency of energy utilization by measuring the power required in relation to work done. a. Using personal experience supplemented by library references, describe ways of conserving energy and how this will affect his life and that of society in general.
	* *Occupational*	a. Learn about occupational opportunities.	a. Find occupational information related to the field of heavy duty mechanic, millwright and machinist.

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MODULE SEVEN

ELECTRO-MECHANICAL CONTROLS AND TROUBLE SHOOTING

I. OBJECTIVES

The objectives of this module are:

1. To familiarize the student with some of the electro-mechanical and electro-fluid systems and various combinations.

2. To give the student the opportunity to study various ways to efficiently convert electrical energy to a mechanical or fluid means of controlling and transforming energy, for practical purposes.

II. REFERENCES

Duffy, Joseph W. POWER; PRIME MOVER OF TECHNOLOGY. Van Nostrand, 1972

Gerrish, Howard. ELECTRICITY. (4th Edition). General Publishing.

Lytel, Allan H. A B C's OF ELECTRIC MOTORS AND GENERATORS. Sams, 1964.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
1. Electrically activated mechanical and fluid sub-systems can be efficiently used to safely control large electrical, mechanical or fluid systems.	1. Energy Conversion -Magnetism -Electricity -Induction -Electro/magnets	Learn to: a. Define terminology.	The student will: a. Given appropriate references, accurately define the following: -the electron theory -voltage -amperage -resistance -series circuit -parallel circuit -five sources of electricity -solenoids -induction -magnetism -electricity -watts -motors -generators and alternators -eddy currents -e.m.f.
	* *Safety*	b. Identify safe acts and conditions.	b. Given suitable manuals, tools and materials, accurately identify and describe the proper use of each.
		c. Identify tools and materials used.	c. Given an operating starter motor and generator (or alternator), apply systems study techniques to observe, determine and record the characteristics of each.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn:	The student will:
	* *Measurement*	a. Units of measurement used: -volts -ohms -amps -watts	d. Consider the various phusical laws involved, such as the law of conservation of energy, to measure the electrical power consumed by a given electric motor and compare this input to the mechanical output. Then compare the mechanical power input to the electrical power output of a given generator or alternator.
	* *Graphic Interpretation*	a. Learn to locate relevant specifications, schematics and drawings: -motor action -generator/alternative action -efficiency -conservation of energy	
Effective control of an electro-mechanical system is achieved through efficient use of insulators, filters and regulating sub-systems.	2. Energy Transfer -Control -Conduction -Insulators -Filtering -Regulation -Efficiency	a. Learn the factors that affect control: -mechanical -electrical -type of circuit -Ohm's Law -soldering -rectification -filtering -regulation.	a. Given appropriate manuals, diagrams, tools, test and operating equipment -dismantle and reassemble a complete D.C.generator -connect D.C.generator fields in a number of different configurations -run speed tests of generators under various loads -calculate efficiency of a D.C. generator wired in different configurations and observe, measure, record and compare the characteristics developed.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
3. An efficient control system depends on proper application of various laws when designing the circuitry.	3. Transmission Laws AC/DC Circuitry Efficiency	Learn about:	The student will:
		a. Electrical and support systems.	b. Given suitable manuals, tools and materials, construct an operational electro-mechanical product, eg. door chime.
	* *Measurement*	b. How to use test equipment to calculate efficiency.	c. Given a defective electro-mechanical or electro-fluidic device, use test equipment in a systematic procedure to trouble shoot the problem.
	* *Safety*	c. How to analyse systems and use trouble-shooting techniques.	d. Given a diagram and a variety of control devices and operating motors, assemble a serviceable system.
			e. Given appropriate manuals, diagrams, test and operating equipment -operate an alternator -calculate the alternator performance characteristics -determine the difference in squirrel cage and wound rotors -dismantle and assemble a complete single phase induction motor -describe split phase principle, purpose and operation of a centrifugal switch -draw diagrams of internal parts, switches, external protection -describe starting circuits and characteristics of a capacitor start split-phase motor -determine and describe control, startir and wiring characteristics for - synchronous motors, shaded pole, univer

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn:	The student will:
			f. List common problems found in electro-mechanical devices and list possible solutions.
. Electro-mechanical systems have been instrumental in the development of our automated industrial society.	Energy Utilization -Magnetism -Torque -Heat		a. Using experience and available resources, determine application of electro-mechanical controls, costs, benefits and consequences of their use.
	* *Consumer Awareness*	Consumer information retrieval.	
	* *Graphic Interpretation*	Analysis procedures -systems study -data collection -measurement and comparisons.	b. Given a Delco-Remy starting motor, an electric door chime and a pneumatic or hydraulic solenoid value, use systems study techniques to analyse and determine the functions and controls involved in the given system.
	* *Safety*	Safety -safe conditions -safe acts.	c. Discuss, determine and list the costs, benefits and consequences resulting from unsafe acts, unsafe conditions and negative attitudes with respect to the following: -live cirsuits -amperage -voltage -capacitors -proper grounding -work surface -safety codes -use of hand tools.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn:	The student will:
		Problem solving techniques: -trouble shooting -systems study.	d. Given a defective motor control system, use proper tools, specifications, schematics and safe practices to trouble shoot the system and repair it.
	* *Societal Implications*	Societal implications: -economic -ecological -human mobility -individual -societal.	e. Drawing from his own background, discuss how electro-motor control systems affect individual lives and society.
	* *Technological Implications*	a. Occupational information.	f. Collect information on occupations related to the field of industrial electrician.
		b. Environmental implications.	

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MODULE EIGHT

ELECTRICAL SYSTEMS

I. OBJECTIVES

The objective of this module is to use electrical sub-systems taken from the internal combustion engine to help students learn about efficient energy conversion, transfer and utilization.

II. REFERENCES

PIPE, TED. Small Gasoline Engine Training Manual. Thomas Allen. 1967

ROTH, ALFRED. Small Gas Engines. General Publishing. 1975

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
1. Mechanical motion may be used to convert magnetism into electrical energy.	1. Energy Conversion -Magnetism -Kinetic -Chemical	Produce electricity by mechanical motion of a magnet.	a. Given a small engine with the flywheel removed, connect a galvanometer in series with the ignition points. With the points in closed position pass a horseshoe magnet past the armature coil assembly and observe galvanometer action. Vary the speed of the magnet movement and observe differing e.m.f. values recorded.
	* *Measurement*	Define terminology.	b. Given appropriate references, define and record the following: -magnetism -electromotive force -voltage -amperage -inductance -capacitance -resistance -primary circuits -secondary circuits.
	* *Graphic Interpretation*	Know tools and material.	
	* *Safety*	Perform safely.	c. Given appropriate references, determine and list all unsafe acts and conditions that must be considered when working on electrical systems.

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
			The student will:
Electrical energy may be amplified and controlled for transmission.	2. Energy Transfer a. Transmission -Primary -Secondary -Circuits, series and parallel -Current -Inductance -Insulation -Amplifiers -e.m.f. -r.e.m.f.	Learn: -how distribution of amplification of a generated voltage is effected by employing a reverse e.m.f. and inductances -how the cam system develops the required dwell angle -effect of broken insulation -importance of accurate timing	a. Given appropriate information and equipment, observe the effect of a coil in a circuit.
	b. Control -Capacitance -Voltage -Inductance -Switching -Fuses -Magnetism -Current -Insulation	-use of the capacitor -function of primary and secondary circuits -control factors -support systems	b. Given a small engine, trace the primary and secondary circuits of the ignition system and identify -magnets -armature -coil -primary lead -points -condensor -secondary lead -spark plug -coil ground lead.
An electric current requires an isolated path from source through the load and back to the source.	* *Measurement* * *Graphic Representation* * *Safety*		

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
			The student will:
4. Heat and light may be produced by means of electrical voltage.	3. Energy Utilization a. Heat -Resistance -Current -Voltage b. Magnetism -Electromagnet -Permanent magnet	Learn to: a. time a small engine b. produce noise electromagnetically c. find consumer information d. understand societal implications of energy utilization	a. Given a single cylinder engine test for spark.
	* *Societal Implication* -economic -ecological -human mobility -on individual -on society		b. Given a vibrator coil (Model T coil), place a piece of paper in the spark gap and note heat produced.
	* *Consumer Education*	e. retrieve occupational information related to -servicing -selling -manufacturing -safety -education -working conditions -physical requirements	c. Given a cylinder engine, observe and record the effects on its operation of the following adjustments to the primary and secondary control switches: -normal point setting -closed points -open points -dirty points -weak condensor -wide spark gap -narrow spark gap -normal spark gap.
	* *Environmental Implications*		d. Given his own experience plus that of others, determine and record the effects of electrical systems on his personal life and on society as a whole.
	* *Occupations*		e. Given reference material, find employment information related to the electrical fiel

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MODULE NINE

NON-CONVENTIONAL POWER SOURCES

I. OBJECTIVES

The objective of this module on Non-Conventional Power Sources is to make the students more aware of the increasing shortage of conventional energy sources by giving them an opportunity to study and experiment with several different power sources to determine their relative efficiency.

II. REFERENCES

DUFFY, JOSEPH W. Power; Prime Mover of Technology. Van Nostrand Reinhold. 1972.

STEPHENSON, GEORGE E. Power Technology. Van Nostrand Reinhold. 1968.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		The student learns about:	The student will:
1. Many extra-ordinary sources of energy can be utilized in man's search for energy to do work for him.	1. Energy Conversion -Solar -Chemical -Thermal -Piezoelectric -Wind -External combustion engine	a. Efficiency of various energy sources.	a. Given solar cells and meters, devise operable circuits and -measure and record output -analyze and compare results.
	* *Measurement*	b. Safe conditions and acts.	b. Given the (Imperial Oil) Fuel Cell instruction, prepare: -electrode plating solutions -electrodes -electrolyte -an operating cell -data sheet -conclusions.
	* *Safety*	c. Graphic interpretation.	c. Given several thermocouples, measure energy produced when -in series -in parallel.
		d. Definitions of terminology.	d. Given appropriate references, define and differentiate between: -Stirling cycle engine -solar cells -fuel cells -thermocouples -piezoelectric criptals -wind energy -batteries -steam engine.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		The student learns about:	The student will:
To be useful, energy must be efficiently insulated, controlled and transferred.	2. Energy transfer -Electron transfer -Connectors -Insulation -Control -Efficiency	a. Units of measurements used. b. Connecting meters into the circuit correctly c. Installing switches rheostats, resistence etc. in various circuits.	a. Use meters correctly to accurately measure and record data such as: -voltage -current -power -temperature for various circuits.
Energy from the sun, chemicals, heat and other sources can be converted to electricity through the use of solar cells, fuel cells and thermocouples.	3. Energy Utilization -Solar -Chemical -Thermal -Piezoelectric -Wind -External combustion -Engine		a. Given the necessary equipment and circuit diagrams, assemble various circuits using non-conventional power sources and: i. analyze data collected to determine costs, benefits and consequences of each device, ii. calculate emersion levels, iii. identify ways of conserving the energy, iv. plot a comparison of performance of each of the sources used.
	* *Safety*		b. Explain the various safety and good housekeeping practices required for equipment.
		a. Consumer information retrieval.	c. Given references, determine applications for the various non-conventional power sources.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		The student learns about:	The student will:
		a. Societal implications for: -economics -ecology -human mobility.	a. Discuss how non-conventional power sources affect or will affect his life, society as a whole and industrial society in particular.
		b. Occupational information related to -service -safety -manufacturing -education -duties -working conditions -physical requirements.	a. Find occupational information related to the research and development of non-conventional power sources.

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MODULE TEN

APPLIANCE REPAIR AND TROUBLE SHOOTING

I. OBJECTIVES

The objectives of this module in Appliance Repair and Trouble Shooting are to:

1. Provide students the opportunity to develop logical trouble shooting techniques.
2. Provide students with experiences in repairing typical appliance faults.

II. REFERENCES

Anderson, Edwin P. HOME APPLIANCE SERVICING. Audel. 1974. #23214. 3rd ed.

Tricomi, Ernest. HOW TO REPAIR MAJOR APPLIANCES. Sams. 1968. #20650. 2nd ed.

Darr, Jack. FIX YOUR SMALL APPLIANCES. Sams (Paperback). #21051, #21052. Vol.I, II.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
1. Electrically energized appliances assist man in his work.	1. Energy Conversion -Electro-mechanical -Electro-fluid -Electro-magnetic * *Safety* * *Measurement*	Define terminology Study and discuss unsafe acts and conditions. Learn the units of measurement involved.	The student will: a. Given appropriate references, accurately define and determine the significance of each of the following: -the electron theory -voltage -amperage -resistance -series -parallel -sources of energy -solenoids -induction -magnetism -eddy currents -mechanical advantage -gear ratios -fluid pressure -fluid flow -valve -continuity -S.C.R. speed control -Vernier caliper b. Based on his own experience, discuss and assess the costs, benefits and consequence of unsafe acts, conditions or attitudes encountered when repairing appliances.

* Common concepts in *script*. These are concepts common to most units.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
			The student will:
Appliances play an important part in today's society as efficient devices to control and transmit mechanical, fluid and electrical energy	2. Energy Transfer -Mechanical advantage -Amplification -Control -Efficiency	Care and use of tools and equipment.	a. Given appropriate manuals, tools and equipment, identify each item and its use.
	* *Graphic Interpretation*	Learn how to get and use information.	b. Given an appliance and service manual, locate the problem, determine the cost of repairs and decide whether the job is worth doing.
	* *Measurement*	Analyze failures related to circuitry, mechanical or other reasons.	c. Develop and record a step-by-step trouble shooting technique involving systems analysis including: -observation -diagrams -cleaning -adjusting -repairing -testing.
	* *Technological Application*	Practice trouble shooting techniques and determine merit of repairing or replacing.	d. Given a defective appliance, determine and record the efficiency of the various sub-systems and their units such as: -electrical, control and transmission devices -mechanical, control and transmission devices -Fluid, control and transmission devices Then compare the same system efficiencies after repair.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
3. The efficient repair of appliances is not only economical, but conserves energy and natural resources.	3. Energy Utilization -Conservation -Economics	Do problem solving.	a. Given a serviceable appliance, use appropriate test equipment to determine pollution and emission levels.
		Discuss societal implications: -economic -ecological -human mobility -individual -societal	b. Given selected defective appliances, analyze the system or sub-system involved and after logical trouble shooting, restore the appliance to service.
	* *Safety*	Make safety check.	c. Discuss and list the costs, benefits and consequences resulting from unsafe acts, conditions and dangerous attitudes with respect to: -live circuits -amperage -voltage -capacitors -overloading -grounding -working surface -safety codes -use and care of hand tools -instrument use

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
	* *Environmental Implications*	Discuss environmental implications: -local sphere -expanded sphere.	d. Discuss how appliance repair and servicing affects his life, industrial society and society as a whole.
	* *Occupations*	Search out occupations information.	e. Find occupational information related to the field of appliance repair.

Common concepts in *script*. These are concepts common to most units.

MODULE ELEVEN

HYDRAULICS AND FLUIDICS

I. OBJECTIVES

The objectives of this module in Hydraulics and Fluidics are to:

1. Give the students an opportunity to assemble, operate and analyze several different hydraulic systems to determine the efficiency of conversion transfer and utilization of energy.

2. Allow the students to design and assemble a simple and logical control system using fluidics.

II. REFERENCES

Dudley A. Pease. BASIC FLUID POWER. Prentice-Hall. 1967. ref.ed. ($15.95)

Duffy, Joseph W. POWER; PRIME MOVER OF TECHNOLOGY. Van Nostrand. 1972. 2nd ed.

Walton, Harry. THE HOW AND WHY OF MECHANICAL MOVEMENTS. Popular Science Books.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
1. A fluid system converts the potential energy found in pressure and the kinetic energy found in flow into a working force. 2. When a laminar fluid flow in one stream is acted on by another fluid stream, the combined energy produces a turbulance that can interupt the original laminar stream thus producing a basic logic signal. 3. Fluid power can be put to work when its motion has been properly controlled and directed.	1. Energy Conversion -Hydrodynamic -Hydrostatic * *Safety* * *Graphic interpretation* 2. Energy transfer -flow -pressure -connectors -control -reservoirs -turbulence -laminar -potential (energy) -kinetic (energy) -logic -pressure differential -returns -Pascal's law -Bernoullis Principle	Learn to: Define terminology. Assemble, operate and control a simple system. List safe practices (acts and conditions). Use tools and materials Read and interpret operator's manual.	The student will: a. Given a selected reference, -differentiate between potential and kinetic energy -define: pressure, flow, force, turbulence, laminar. b. Given the appropriate components and operator's manual, assemble and operate a simple system as directed by the operator's manual. a. Given appropriate references, define the concepts under Topic 2, "Energy Transfer" b. Given the equipment and manual, assemble and operate a simple hydraulic system. c. Given adequate components and a practical problem in hydraulics-, design, assemble, and operate a system to achieve the results desired.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
4. The pressure which forces a fluid stream into motion can be altered to introduce turbulance into a laminar flow to create a predictable and logical order.	* *Graphic Interpretation*	Read diagrams and graphs.	a. Given a working hydraulic system (from a car, farm implement, etc.), analyze and explain the function of each component, the principles upon which they work, and the control mechanisms for the system.
	* *Safety*	Consider unsafe acts and conditions relative to hydraulics.	b. List the unsafe acts and conditions that could lead to human and equipment damage.
5. The relative incompressibility of liquids (as compared with gases) permits their use where a force is required.	3. Energy Utilization	Define new terms.	
6. Pressure differentials can be used to inject a substance into a flowing stream (venturi) or to attach a flowing stream to a wall.	-hydrostatic -hydrodynamic -control -pressure differential -potential energy -kinetic energy -flow -logic -pressure -motion -rotary -linear -reservoirs		
7. Liquids can be used in many ways to power mechanics.			a. Given resource material and personal experience, list applications of hydraulic devices in many spheres of man's work.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
			The student will:
8. Fluids can be used to control automated equipment through the application of fluidic logic. 9. The use and control of fluids has added a versatile and dependable force to our industrial complex.	* *Sociological Implications* * *Occupations*	Study sociological implications: -economic -ecological -effect on mobility the individual society as a whole. Retrieve occupational information: -education requirements -physical requirements -working conditions -salaries -duties.	b. Using library resources, prepare an essay on the application of fluid systems and their sociological implications. c. Given practical problems and an assortment of components, design and assemble fluid system to solve the problems. d. Given a working model of refrigerator, analyze and describe the functions of the various units and components within the refrigerator system. e. Given occupational information, assess personal interest and compatibility for work in hydraulics and fluidics.

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MODULE TWELVE

PNEUMATICS AND FLUIDICS

I. OBJECTIVES

The objectives of this module in Pneumatics and Fluidics are to:

1. Assemble, operate and analyze several different pneumatic systems to determine the efficiency of conversion, transfer and utilization of energy.

2. Design and assemble simple and logical control systems using fluidic devices.

II. REFERENCES

Compressed Air Institute. COMPRESSED AIR HANDBOOK. Compressed Air Institute
122 East 42 Street, New York, 10017

Duffy, Joseph W. POWER; PRIME POWER OF TECHNOLOGY. Van Nostrand. 1972. 2nd ed.

Walton, Harry. THE HOW AND WHY OF MECHANICAL MOVEMENTS. Popular Science Books.

GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
		Learn to:	The student will:
1. A fluid system converts the potential energy found in pressure and kinetic energy found in flow into a working force.	1. Energy Conversion -hydrodynamic -hydrostatic	Define terminology. Assemble and operate a simple system.	a. Given a selected reference: -differentiate between potential and kinetic energy -define: pressure, flow, force, turbulence, laminar.
2. When a laminar fluid flow in one stream is acted on by another fluid stream, the combined energy produces a turbulance that can interrupt the original laminar stream, thus producing a basic logic signal.	* *Graphic Interpretation* 2. Energy Transfer -flow -pressure -control -laminar -turbulence -reservoir -energy -potential -kinetic -logic -pressure -Pascal's law -Bernoullis Principle	Read and interpret operator's manual. Define new terms.	b. Given the appropriate components and operator's manual, assemble and operate a simple system as directed in the manual. a. Given appropriate references, define the terms and concepts listed under Topic 2, Energy Transfer. b. Given the appropriate components and an operator's manual, assemble and operate a simple fluidic system. c. Use the system assembled in (b) to obtain data on pressure readings.
3. The easy compressibility of air provides an environmentally clean and economic energy source.			
4. Fluid power can be put to work when its motion has been properly directed and controlled.			

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
			The student will:
5. The pressure which forces a fluid stream into motion can be altered to introduce turbulence into a laminar flow to create a predictable and logical order.		Analyze a simple system.	d. List safety and health hazards as they apply to fluidic systems.
6. The relative incompressibility of liquids (as compared with gases) permits their use where a positive force is required. Pressure differentials can be used to inject a substance into a flowing stream (venturi) or to attach a flowing stream to a wall.		Learn safe practices.	
7. Air can be used in many ways to activate and control machines.	3. Energy Utilization -motion -rotary -linear -pressure -flow -logic -energy -potential -kinetic -pressure differential -control -hydrostatic -hydrodynamic	Define new terms.	a. Given library resources, determine the applications of fluid systems to industry and the consequent sociological implications. b. Given several practical problems and an assortment of components, design and construct a fluidic system to solve preselected problems.

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GENERALIZATIONS	TECHNICAL AND *COMMON CONCEPTS	LEARNING TASKS	BEHAVIOURAL OBJECTIVES
			The student will:
8. Complex industries depend on automated controls made possible by fluids and fluidic logic. 9. Air is an economical, reliable and clean substance with many uses in industry.	* *Measurement* * *Graphic Interpretation* * *Occupational Information*	Study sociological implications -economic -ecological -societal. Study effects on individual on mobility.	c. Given a working model of a refrigerator, analyze and describe the functions of the various units and components within that system. d. Study in depth at least one occupation related to fluidics technology.

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E. GENERAL MODULES

1. Research Module

The purpose of the Research Module is to allow individual students to engage in an in-depth study of a problem related to any of the career fields.

The time period is 25 hours and qualifies as a regular module.

The module provides for individualizing the program to allow for special interests of students. The student should prepare a proposal of his research and have it approved by the teacher. The proposal should contain:

a) A statement of the problem.
b) The procedure to be followed in the research of the problem.
c) A list of the materials and lab facilities to be used
d) A time line of activities.

2. Developmental Module

The purpose of the Developmental Module is to provide a 25-hour block of time for the teacher to try out new content with his class. The content of the proposal or project should be discussed with the Associate Director of Curriculum for Industrial Education.

3. Production Service Module

The purpose of Production Service is to provide for a class project in setting up a company to produce a product or service.

The Production Science 30 course will provide an outline from which content may be selected to develop a 25-hour module. The Production Science 30 is a full 4-5 credit course so the teacher must be selective in choosing the content for a 25-hour or one-credit module.

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CURRICULUM GUIDE